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REVIEWS AND BOOK NOTICES.

THE GEOLOGY OF THE LOWER AMAZONAS.*—*The Ereré-Monte-Alegre District and the Table-topped Hills.* In this paper Prof. Hartt has given us a very interesting account of a part of his careful explorations on the Lower Amazonas. In the fall of 1870, a month was spent in the vicinity of Ereré with three assistants, and in the following year, nearly as much time was given to the same neighborhood in company with Mr. O. A. Derby, his present assistant. A large portion of the ground was gone over on foot and field notes and sketches carefully made. The results of Prof. Hartt's labors are of extreme interest, as they clear up many uncertainties in regard to the age of the sandstones and shales of Ereré, supposed by the late Prof. Agassiz to be of glacial origin. They really belong as far back as the Palæozoic age. Space will permit us to give but a brief outline of the main portion of the paper, in connection with the sketches illustrating it, the cuts of which have been kindly loaned by the Buffalo Society of Natural Science.

To the northwest of Monte-Alegre, a town situated on the Rio Curupatúba, near where it enters the Amazonas, and distant 350–360 miles nearly directly west of Pará, is quite an extensive plain, surrounded on all sides by hills and high grounds. The distance across the plain from north to south is about fifteen miles, its width from east to west is over ten miles. It lies somewhat higher than the alluvial plains of the Amazonas, and is drained by the Igarapé of Ereré, a small stream flowing into the Igarapé of Paitúna, which in turn enters the Rio Curupatúba some distance below Monte-Alegre. The structure of the plain of Ereré is very simple, for it is composed of nearly horizontal strata of Devonian age, through which the small Igarapé has worn a little valley, narrow toward the north where the stream flows over the bare rocks, but broader below and partly filled in with alluvial deposits, lying below the level of the plain. The rocks project in low bluffs along the edge of the valley, and about fifteen feet in thickness of the Devonian beds are exposed, where the road from the

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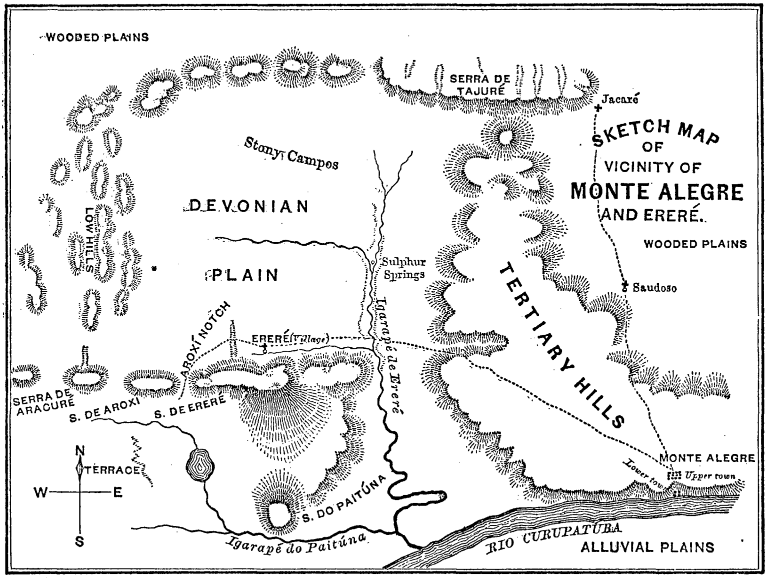
*Contributions to the Geology and Physical Geography of the Lower Amazonas. By Ch. Fred. Hartt, Professor of Geology in Cornell University. Bulletin of the Buffalo Society of Natural Science, vol. 1, No. iv, Jan., 1874, pp. 201-235.

Igarapé to Ereré crosses the bluff on the west. The beds composing the lower part of this bluff consist of a "soft, well-laminated, fine-grained shale, dark gray in color, alternating with white or red layers, and consisting of a fine, more or less sandy silt, with an abundance of little flakes of mica." One species of Discina and two of Lingula were obtained from the variegated shales. The former has been identified with a New York species, *Discina lodensis* of Hall from the Genesee shale, and is very abundant. Above the shales is a heavy bed of red and white clay rock, containing only obscure markings, the whole having a slight inclination to the southeast. In the northwestern part of the campo, Prof. Hartt found, that "the rock varies from a very hard, dark-colored, silicious shale, to a well-bedded, dark-gray, compact, cherty rock, breaking with a conchoidal fracture." These were the lowest beds of the series examined. Fragments only of fossils were obtained from the more shaly portions. Following the Monte-Alegre trail eastward from the igarapé, light-colored shales with thin bands of a reddish sandstone, full of fossils, are found just before reaching the Monte-Alegre highlands. The fossils belong to common Devonian genera. In a large open campo, to



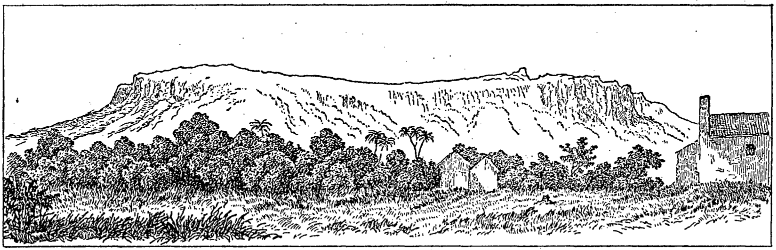
the north of the town of Ereré, at a distance of about two miles are red and whitish sandstones with whitish or yellowish shales. The sandstone is seldom seen *in situ*, but usually occurs in loose angular fragments. It affords an abundance of fossils, and forms the best collecting ground known on the plain. At this point Prof. Hartt and Mr. Derby made a very large collection of fossils. It represented ten genera of Brachiopods, about the same number of genera of Lamellibranchs and Gasteropods, two species and genera of Trilobites and several other forms. After a careful comparison of these with North American and European collections, several of the species were found to be identical with species occurring in the Hamilton group of New York, and described by Prof. Hall. So the conclusions are, that the sandstones and shales of the Ereré plain were formed at a period, corresponding to that in which the Hamilton shales were laid down, in North America.

The surface characters of the plain are in strict keeping with its simple structure. To the eastward of the Igarapé, it stretches to the foot of the Monte-Alegre highlands, almost as level as a floor, the Palæozoic rocks passing beneath the highlands. To the westward, as we approach Ereré, the plain forms a flat or rolling open campo, with long gentle ascents and descents. There is very little soil on any part of the plain, the surface of which is usually covered with angular fragments of red sandstone or rounded iron nodules. The campo is sparingly covered with grass, while the trees are few, stunted and scattered. Several large dykes occur on the plain.

Having gone over, though very hastily, what seems to be the most interesting part of Prof. Hartt's paper, as it is the richest in results, let us, by the aid of his sketches and descriptions, examine the surrounding hills. They form almost a square, protecting the level plain on all sides; to the eastward lie the Tertiary hills of Monte-Alegre, made up in large part of a single ridge, and extending from the Curupatúba on the south nearly to the Serra of Tauajurí on the north. They have a height of about 500 or 600 feet, are composed of horizontal beds of clays and sands, probably of Tertiary age, and seem to be "a degraded outlier of the once extensive formation of the serras of Parú." The upper town of the villa of Monte-Alegre is placed upon its summit, above the Rio Curupatúba, toward which the descent is very rapid.

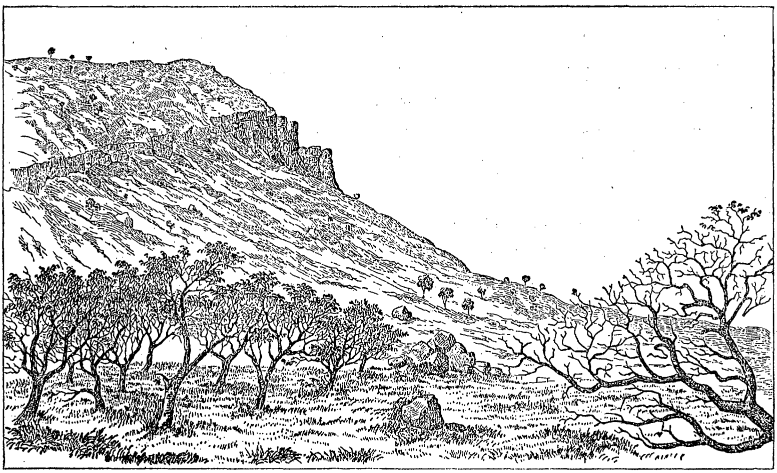
The Serra of Ereré forms a part of the southern boundary of the plain. On its east, between the serra and the igarapé, is a plateau, made up, at least in part, of obliquely laminated beds of tinted sands and clays. "The serra is a high, narrow, rugged, irregular ridge, four or five miles long, trending about east-north-east and west-south-west, and with abrupt and often precipitous sides." The top of the ridge is very irregular, composed of heavy beds of sandstone which are often exposed in ledges, or lie strewn about the surface in huge blocks. The sandstones form a line of bluffs along the upper part of the serra on its northern side, beneath which the slope is very rapid. At both ends the serra terminates

Fig. 93.



Serra of Ereré from the North.

Fig. 94.

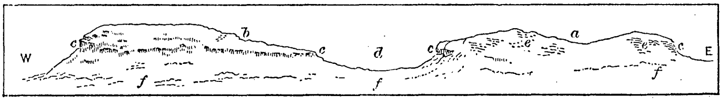


Serra of Ereré from the East.

quite abruptly, as represented in the following cut showing it from the east.

Just west of the Serra of Ereré is a short ridge, with the same trend and geological structure, called Aroxí. This is followed by several still smaller ridges, apparently part of the same outcrop.

Fig. 95.

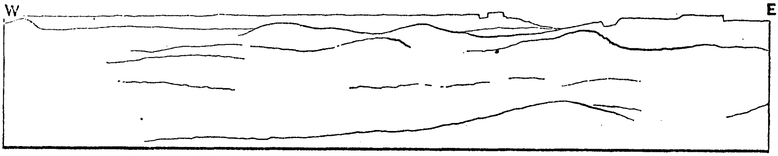


Serras of Ereré and Aroxí from the Southwest.

The Serra of Paitúna, near the igarapé of the same name, is composed of horizontal beds of the same sandstone as that of the Serra of Ereré, "so that the two serras probably form part of a synclinal fold." The sandstones forming the Serra of Ereré are well jointed and of unequal hardness. On weathering, they have assumed many curious forms, some of which are covered with Indian inscriptions and paintings. Fragments of silicified wood have been found in the stone, but they are too poorly preserved to admit of identification. Thus we have no palæontological evidence as to the age of these sandstones, which may be older or newer than those of the plain to the north.

Looking northeastward from the Serra of Ereré, beyond the northern termination of the Monte-Alegre highlands, we see the Serra of Tauajurí, a "splendid, blue, mountain mass, which, with precipitous front, heaves its back against the horizon, like a giant wave ready to break upon the level plains of Ereré, that lie spread out before us. While, northward from the hills (of Aroxí and Aracurí) stretches a belt of low, wooded ridges, skirting the campos on the west and north, and bending round to close the circuit with Tauajurí."

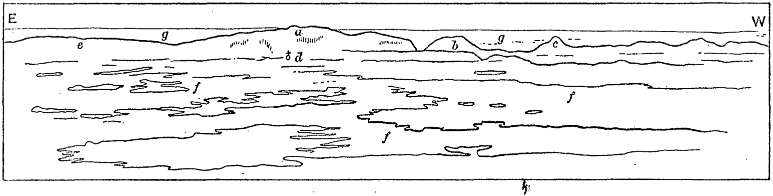
Fig. 96.



Sketch looking northward from Serra of Ereré.

The Serra of Tauajurí is a sharp-crested ridge, exceedingly steep on the southern side, but sloping off at an angle of 10°–15° on the northern. Its highest point is about 850 feet above the level of the sea, and it appears to differ entirely from Ereré in its geological structure. The view from the summit extends over an immense area, the entire Ereré-Monte-Alegre highlands and the Devonian plain being in sight.

Fig. 97.

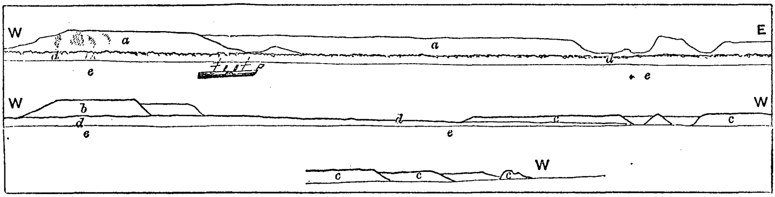


The Devonian Plain and Serras of Ereré from the Serra of Tauajurí.

The description of the table-topped hills to the eastward of Monte-Alegre, which have been the subject of much discussion, we copy verbatim:

"The table-topped hills of the Amazonas, so frequently described by travellers, consist of several isolated mountains or plateaus of circumdenudation composed of horizontal strata, which lie on the northern side of the river between Prainha and Almeirim, and known collectively as the Serras of Parú. They are characterized by their flat level tops and their very abrupt, sometimes precipitous sides. The westernmost of these serras is that of Parauáquára, eastward of which is that of Velha Pobre, while still farther east are the Serras of Almeirim. The general appearance of these mountains is represented in the following sketch made from the river."

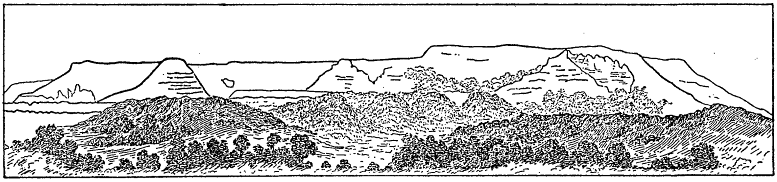
Fig. 98.



Serras of Parú from the Amazonas.

"The serra of Parauáquára is distant, as nearly as I can judge, about twenty miles to the eastward of the fazenda" (of L. J. Rodrigues on the Igarapé of Marapí). "It is an extensive, isolated plateau of circumdenudation, and apparently forms a long, narrow, irregular strip, running east-west. The following sketch, taken from a point a few miles west of the mountain, will show its topographical features as seen in elevation."

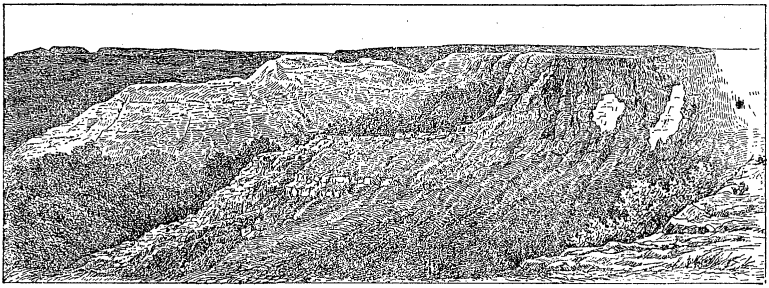
Fig. 99.



Serra of Parauáquára from the West.

"The following cut is from a sketch taken from the top of the serra, looking off northward along the western side, showing the level-topped summit, and the steep sides and spurs, along which run the edges of the horizontal strata like courses of masonry."

Fig. 100.



Serra of Parauáquára from the top looking northward.

No fossils have been found in the Parauáquára beds and their age is undetermined.—R. R.

We may add that the excellent palæontological work by Mr. Rathbun "On the Devonian Brachiopoda of Ereré, Province of Pará, Brazil," follows and supplements Prof. Hartt's paper, and is illustrated with three heliotypic plates, containing one hundred and one figures. The author draws the following conclusions from his study of the Brachiopod fauna of Ereré:—

"Although the fossils so far obtained from Ereré, were collected from so small an area and so limited a thickness of rock as to render it unsafe to draw any extended or definite conclusions from them; yet the Brachiopod fauna, such as it is, resembles so closely that of the Hamilton group of New York state, as to leave no doubt that the beds in which it was found, the sandstones and shales of Ereré, represent about the same horizon as the Hamilton group of North America. Not only are characteristic Hamilton group genera found in the Ereré beds, but even species of those same genera, which cannot be separated from North American species of the Hamilton group."